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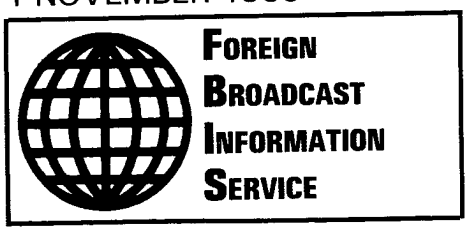

JPRS Report

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CONTENTS

PHYSICS

State S&T Commission Announces National-Level Torch Plan Projects for 1988, 1989

272 Torch Plan Projects Announced

40080231 Beijing KEJI RIBAO [SCIENCE & TECHNOLOGY DAILY] in Chinese 6 Aug 89 p 1

[Article by KEJI RIBAO reporter Han Yuqi [7281 3768 3825]: "State Science and Technology Commission Announces National-Level Torch Plan Projects—272 Projects at Advanced Technological Levels Chosen, With High Increases in Taxable Profits, and Short Startup Schedules"]

[Text] The State Science and Technology Commission has announced a group of national-level Torch Plan projects. Chosen were 272 projects with advanced technical levels, high increases in taxable profits, and short startup schedules.

Since implementation in August 1988, the Torch Plan has received attention and support from scientific research units and scientific research organs throughout China. China's provinces, municipalities, and departments have submitted a total of 1,500 Torch Plan projects. In 1988, the State Science and Technology Commission Torch Plan Office organized an examination and approval of 38 national-level Torch Plan projects. To reinforce project management, the State Science and Technology Commission established the Torch High-Technology Industry Development Center in 1989. Under direct leadership by State Science and Technology Commission Vice Minister Li Xu'e [2621 4872 6759] and guidance by the Torch Office, the Torch Center organized experts to evaluate the 1,500 projects submitted. Based on the evaluation and appraisal opinions, the State Science and Technology Commission approved 234 national-level Torch Plan projects for 1989 and combined 1988 and 1989 to make a total of 272 projects which were announced as the first group of Torch Plan projects.

The principles for establishing national-level Torch Plan projects restrict them to the five areas: New materials; Biotechnology; Electronics and information; Electromechanical integration; and New energy sources, high efficiency, and energy conservation. They must meet advanced technical standards, be mature technical achievements, and be capable of being produced in large or small amounts (projects which have already attained large-scale production were not included in the Torch Plan). They must have good market prospects for products, particularly projects for exports to earn foreign exchange or import substitutes to save foreign exchange. They must have high economic results, short startup schedules, an input/output ratio of about 1:5, and taxable profits over 25 percent. They must be capable of forming an economy of scale and have yearly value-added output in excess of 5 million yuan after project completion. They must digest and absorb imported technologies and gradually achieve domestic production. They should conform to state policies for industrial readjustment, and so on. An example is the "thermally isostatic pressure manganese-zinc-iron oxide magnetic head material" project established by the Xishui County Electronic Equipment and Instruments Plan in Hubei Province and the Ministry of Machine-Building and Electronics Industry's No 33 Research Institute. China now relies entirely on imports [of this material]. This project was successfully developed by the Ministry of Machine-Building and Electronics Industry's No 33 Research Institute and its performance is roughly equivalent to similar products from the United States and Japan. The total project investment was 8 million yuan and the yearly output value may reach 40 million yuan, with yearly taxable profits of 16 million yuan and foreign-exchange savings of $4.2 million annually. A Limulus [i.e., horseshoe crab] reagent project established by the Marine Organic Products Plant in Zhanjiang City's economic and technology development zone can produce 200,000 milliliters annually and the primary technical indicators meet international standards. The total investment in this project was 4.9 million yuan. It can produce 28.16 million yuan in yearly output value, annual taxable profits of 11.6 million yuan, and save US$1.9 million in foreign exchange yearly.

List of National-Level Torch Plan Projects

40080231 Beijing KEJI RIBAO [SCIENCE & TECHNOLOGY DAILY] in Chinese 6 Aug 89 p 4

[List of projects announced by the State Science and Technology Commission, 31 July 1989: "National-Level Torch Plan Projects for 1988, 1989"]

[Text]

Preface

The Torch Plan is a guidance-type development plan approved by the State Council. Its implementation is the responsibility of the State Science and Technology Commission. Its goal is to promote the conversion of high technology and new technology into commodities and to promote the formation and development of high-technology and new-technology industries in scientific research institutes, institutions of higher education, and large and medium-sized enterprises. Projects included in the Torch Plan must have good market prospects, high technical levels, substantial economic benefits, a capacity for forming economies of scale and stronger competitive ability. To date, on the basis of applications by science and technology commissions in all areas and central departments, we have organized experts in the relevant areas to survey and appraise the projects and to select 272 projects (38 for 1988 and 234 for 1989) which fall into the five main categories: new materials; biotechnology; electronics and information; electromechanical integration; and new energy resources, high-efficiency products, and energy conservation. They were approved by the State Science and Technology Commission as

national-level Torch Plan projects and their implementation is to be organized by the various applying and responsible units. The state will provide these projects with some special loans and preferential policies.

I. 1988 National-Level Torch Plan Projects

1	Gallium-arsenide and III-V-group compound semiconductor materials	New materials	Beijing	
2	Gallium-arsenide monocrystals and polishing disks	New materials	Beijing	
3	Hyperpure ultrafine zirconium oxide powder	New materials	Beijing	
4	Ultrafine ceramic powder and abrasion-resistant components	New materials	Beijing	
5	Single-stone piezoelectric ceramic high-voltage transformer	New materials	Beijing	
6	Rare-earth permanent magnetic materials and products	New materials	Beijing	
7	Zirconium-oxide artificial gem ornaments	New materials	Beijing	
8	Genetically engineered a-interferon	Biotechnology	Beijing	
9	Hyperoxide disproportionated enzyme	Biotechnology	Beijing	
10	Hematopoietin	Biotechnology	Beijing	
11	Satellite TV dual-program receiving station	Electronics and information	Beijing	
12	Laser dual-wavelength precision measurement system for large equipment	Electronics and information	Beijing	
13	FORTH-language-oriented multiple-thought new-generation computer	Electronics and information	Beijing	
14	Chinese-English and English-Chinese computer-aided translation system	Electronics and information	Beijing	
15	Computer-aided Chinese teaching system	Electronics and information	Beijing	
16	JH high-frequency non-intermittent power supply system	Electronics and information	Beijing	
17	(JH) multilayer dielectric-film full-transmission luminescent lamp	Electronics and information	Beijing	
18	Automatic control system for mixing wet cement	Electronics and information	Beijing	
19	Saticon [selenium-arsenic-tellurium television camera tube]	Electronics and information	Beijing	
20	18-ton amphibious high-performance passenger-cargo hovercraft	Electromechanical integration	Beijing	
21	Cable-transmission numerically control oil-well logging system	Electromechanical integration	Beijing	
22	High-frequency electrical semiconductor components and frequency-conversion power supply	High efficiency and energy conservation	Beijing	
23	Sweet chrysanthemum glucc side	Biotechnology	Tianjin	
24	High-efficiency continuous isoelectric point crystal extraction of glutamic acid	Biotechnology	Tianjin	
25	Transducer module for instruments and meters	Electronics and information	Tianjin	
26	High-power guide-vane adjustable axial-flow wind machine	High efficiency and energy conservation	Heilongjiang	Harbin
27	High-efficiency energy-conserving fluid machinery and systems	High efficiency and energy conservation	Zhejiang	Shangyu
28	Millimeter-wave communications system product series	Electronics and information	Anhui	Hefei
29	Three-primary-color fluorescent powders	New materials	Jiangxi	Jiujiang
30	Non-specific causative agent chicken-egg-and-blood serum for vaccines	Biotechnology	Shandong	Jinan
31	Unusually beautiful artificial skin	Biotechnology	Shandong	Weihai
32	Full-extraction rare-earth continuous separation and smelting	New materials	Shandong	Zibo
33	New type of fire-retardant low-toxicity phenolic foamed plastic	New materials	Henan	Luoyang
34	B-HCG monoclonal antibody enzyme-tagged diagnosis box	Biotechnology	Henan	Zhengzhou

I. 1988 National-Level Torch Plan Projects (Continued)

35	Fully automatic control grass pulverizer	Electromechanical integration	Henan	Zhengzhou
36	(0.1 mm) high-tolerance electrical strength F-grade composite insulating material	New materials	Hubei	Wuhan
37	Micro-semiconductor cooling component	New materials	Hunan	Jinshi
38	High-grade voltage-sensitive resin for use in industry	New materials	Guangdong	Guangzhou

II. 1989 National-Level Torch Plan Projects

1	TEB low-adhesion wide temperature liquid-crystal-display material	New materials	Beijing	
2	Spectrum separation medium and separation column	New materials	Beijing	
3	Spherical welding wire for use in integrated circuits	New materials	Beijing	
4	Nuclear-magnetic-resonance imaging permanent magnet	New materials	Beijing	
5	High-efficiency, high-purity rare-earth permanent magnet material	New materials	Beijing	
6	Ethyl chloroxide catalyst	New materials	Beijing	
7	Oxygen-permeated oxygen-rich membrane for medical use	New materials	Beijing	
8	Artificial high-strength diamonds	New materials	Beijing	
9	Neodymium-iron-boron permanent magnetic material and applied products	New materials	Beijing	
10	Chorionic membrane gonadotropic hormone-HCG	Biotechnology	Beijing	
11	Glucosan enzyme	Biotechnology	Beijing	
12	Broad-spectrum crop-yield-increasing bacteria	Biotechnology	Beijing	
13	SB micro blood slide	Biotechnology	Beijing	
14	Extraction of bilirubin from pig's blood	Biotechnology	Beijing	
15	Haihua AT-1204 microcomputer system motherboard	Electronics and information	Beijing	
16	Color high-resolution graphics image display and processing system	Electronics and information	Beijing	
17	SP-4 and CPS-861 image communications via digital terminal equipment	Electronics and information	Beijing	
18	TJ-2230 computer system	Electronics and information	Beijing	
19	HCG-1280 high-resolution color graphics control board	Electronics and information	Beijing	
20	STD-Bus industrial control computer system	Electronics and information	Beijing	
21	Pocket wireless paper	Electronics and information	Beijing	
22	Huaguang IV electronic photodischarge printing system	Electronics and information	Beijing	
23	Associative 286 microcomputer	Electronics and information	Beijing	
24	Quartz-wrapped tube and large-diameter quartz tube for use in optical-fiber production	Electronics and information	Beijing	
25	BF386 computer-aided Chinese language teaching system	Electronics and information	Beijing	
26	ST-IMS-88 ion mass spectrometer	Electronics and information	Beijing	
27	SP-32 electric-spark forming and processing numerical control system	Electromechanical integration	Beijing	
28	General-purpose control system for industrial robots	Electromechanical integration	Beijing	
29	GS100-GS8100 grating digital display instrument	Electromechanical integration	Beijing	
30	Grating digital display system for use in numerically controlled machine tools	Electromechanical integration	Beijing	
31	Megawatt-level high-power laser machining system	Electromechanical integration	Beijing	
32	Microcomputer-controlled plasma blended gold-plating machine	Electromechanical integration	Beijing	

II. 1989 National-Level Torch Plan Projects (Continued)

33	Ceramic electrically heated film	High efficiency and energy conservation	Beijing	
34	SIGMA dual-U electronic energy-saving fluorescent bulb	High efficiency and energy conservation	Beijing	
35	Superpolymer polyvinyl grinding disk for use in papermaking	High efficiency and energy conservation	Beijing	
36	Induced Sanmian silkworm fine silk and products	Other	Beijing	
37	High-power gamma radiation connecting cable and wire	Other	Beijing	
38	Color TV line-output transformer-case sealing material	New materials	Tianjin	
39	Purified KL-basic proteinase	New materials	Tianjin	
40	TJG85/88 multipurpose environment-resistant ruggedized computer	Electronics and information	Tianjin	
41	TEB30-40 liquid crystal display material	New materials	Hebei	Shijiazhuang
42	Digital/analog signal mixing transmission equipment	Electronics and information	Hebei	Shijiazhuang
43	Thousand-switch program-controlled digital subscriber [telephone] exchange	Electronics and information	Hebei	Shijiazhuang
44	Satellite communications antenna and KU-band satellite TV receiving antenna	Electronics and information	Hebei	Shijiazhuang
45	High-precision temperature-compensated crystal oscillator	Electronics and information	Hebei	Shijiazhuang
46	2GC digital microwave communications equipment	Electronics and information	Hebei	Shijiazhuang
47	Fully automated solid repository control and management system	Electromechanical integration	Shanxi	Taiyuan
48	Durable tuyere and new materials for blast furnaces	New materials	Inner Mongolia	Baotou
49	Neodymium-iron-boron hypervelocity special electrical equipment	Electromechanical integration	Inner Mongolia	Baotou
50	Methyl-glucose glucoside	New materials	Liaoning	Shenyang
51	High-elasticity PBT short fibers and imitation wool products	New materials	Liaoning	Shenyang
52	Neodymium-iron-boron permanent magnetic material and electrical machinery products	New materials	Liaoning	Shenyang
53	Organic material for use as color projection film	New materials	Liaoning	Shenyang
54	Non-crystalline-state alloy extracted from paigeite [Fe-B mineral]	New materials	Liaoning	Shenyang
55	S3-LM12 four-coordinate numerically controlled lathe	Electromechanical integration	Liaoning	Shenyang
56	Underwater-robot product series	Electromechanical integration	Liaoning	Shenyang
57	Industrial robot controller with a movement-level language	Electromechanical integration	Liaoning	Shenyang
58	HV-1 and DJG multipurpose light aircraft	Other	Liaoning	Shenyang
59	Explosive processing and explosive composite material	New materials	Liaoning	Shenyang
60	Ion-bombardment spreading device	Electromechanical integration	Liaoning	Dalian
61	Copying milling-machine numerical-control system	Electromechanical integration	Liaoning	Dalian
62	Fire-retarding material containing carbon-magnesium and bonding agent	New materials	Liaoning	Anshan
63	Polymer functional membrane and membrane separation device	New materials	Liaoning	Jinzhou
64	Dispersion method extraction of polytetrafluoride vinyl resin	New materials	Liaoning	Fuxin
65	AC frequency-conversion adjustable-speed device and product series	Electromechanical integration	Liaoning	Liaoyang
66	Metallic ceramic oxygen spray tube and blast furnace tuyere	New materials	Liaoning	Yingkou

II. 1989 National-Level Torch Plan Projects (Continued)

67	Electrochemical-method synthesis of ferrocene	High efficiency and energy conservation	Liaoning	Yingkou
68	Modified ABS and HIPS engineering plastics	New materials	Jilin	Changchun
69	Solid flat-screen microcomputer terminal display	Electronics and information	Jilin	Changchun
70	Grating digital-display sensor	Electronics and information	Jilin	Changchun
71	Coke molecular-sieve air regulator	Other	Jilin	Changchun
72	Radiation-prepared highly absorbent polymer material	New materials	Heilongjiang	Harbin
73	CSC ultra-high-capacity capacitor	Electronics and information	Heilongjiang	Harbin
74	Steel-wrapped-steel water-measurement system	Electronics and information	Heilongjiang	Harbin
75	High-power microwave source for cancer therapy	Other	Heilongjiang	Harbin
76	FC epoxy film plastic	New materials	Shanghai	
77	Radiation stem grafting polyvinyl alkaline battery separation membrane	New materials	Shanghai	
78	Rare-earth three-primary-color fluorescent powders for use in lights	New materials	Shanghai	
79	F46 fusible fluororesin	New materials	Shanghai	
80	SPF-grade laboratory animal breeding system	Biotechnology	Shanghai	
81	Black-and-white and color multifunction fish locator	Electronics and information	Shanghai	
82	Color TV infrared remote-controlled emitter and receiver	Electronics and information	Shanghai	
83	Fiber-optic communications coupler series	Electronics and information	Shanghai	
84	CX-960 and 851 medical B super diagnostic instrument product series	Electromechanical integration	Shanghai	
85	ZF2-3D55 three-coordinate automatic copying milling machine	Electromechanical integration	Shanghai	
86	Environment-resistant electrohydraulic servo and ratio components and control system	Electromechanical integration	Shanghai	
87	50,000-400,000 image-beam large-section fiber-optic image-beam-transmission product series	New materials	Jiangsu	Nanjing
88	Special coating for adjustable temperature glass	New materials	Jiangsu	Nanjing
89	High-purity special alkyl gas	New materials	Jiangsu	Nanjing
90	Fixing enzyme technology production of L-malic acid	Biotechnology	Jiangsu	Nanjing
91	PSC-128B program-controlled subscriber-line concentrator	Electronics and information	Jiangsu	Nanjing
92	Power-grid electrical load controller	Electronics and information	Jiangsu	Nanjing
93	High-precision computer dynamic measuring device	Electromechanical integration	Jiangsu	Nanjing
94	JWK series economical numerical control system	Electromechanical integration	Jiangsu	Nanjing
95	CNK360 numerically controlled all-purpose lathe	Electromechanical integration	Jiangsu	Nanjing
96	Sequential-pulse laser holographic projector	Other	Jiangsu	Nanjing
97	Light emitting diode and tube core	Electronics and information	Jiangsu	Suzhou
98	Computer embroiderer and program compiling system	Electromechanical integration	Jiangsu	Suzhou
99	New electronic electroheating material	New materials	Jiangsu	Wuxi
100	High-precision electronic-feed internal grinding machine	Electromechanical integration	Jiangsu	Wuxi
101	Yarn pulling-strength automatic tester	Electronics and information	Jiangsu	Lianyungang
102	High-precision digital-analog converter	Electronics and information	Jiangsu	Lianyungang
103	Reverse-osmosis membrane and membrane separation device	New materials	Zhejiang	Hangzhou
104	Oil-well pump multi-parameter loop-control logging system	Electronics and information	Zhejiang	Hangzhou
105	Automatic jacquard-weave color line control system	Electromechanical integration	Zhejiang	Hangzhou
106	Electrohydraulic ratio components and control system	Electromechanical integration	Zhejiang	Hangzhou

II. 1989 National-Level Torch Plan Projects (Continued)

107	Aluminum-alloy anti-explosion material	New materials	Zhejiang	Ningbo
108	[Human menopausal] gonadotropic hormone (HMG) and [Human] chorionic gonadotropic hormone (HCG)	Biotechnology	Zhejiang	Ningbo
109	Blood-system digital image reducer	Electromechanical integration	Zhejiang	Ningbo
110	DF-4075 dynamic signal analyzer	Electromechanical integration	Zhejiang	Ningbo
111	Wide-range adjustable speed DC servomotor	Electromechanical integration	Zhejiang	Ningbo
112	Ultrapure aluminum-oxide powder	New materials	Zhejiang	Danshan
113	Thin plate welder	Other	Zhejiang	Jinhua
114	New type of electrode	Other	Zhejiang	Jinhua
115	Tunnel radio communications equipment	Electronics and information	Zhejiang	Jiaxing
116	Automatically controlled new warp knitting machine	Electromechanical integration	Zhejiang	Shaoxing
117	Aqueous polyurethane leather spreading agent	New materials	Anhui	Hefei
118	High-resolution medical artificial lens crystallina	Biotechnology	Anhui	Hefei
119	EGG-A electrogastrograph and product series	Biotechnology	Anhui	Hefei
120	Subminiature carbon-dioxide laser therapeutic device	Electronics and information	Anhui	Hefei
121	AV3611 automatic scalar network analyzer	Electronics and information	Anhui	Bengbu
122	AV3613X automatic RF analysis system	Electronics and information	Anhui	Bengbu
123	AV2494 intelligent optical power meter	Electronics and information	Anhui	Bengbu
124	AV3628 intelligent optical time-domain reflectometer	Electronics and information	Anhui	Bengbu
125	AV33117 fully automatic single-mode optical-fiber fusion splicer	Electromechanical integration	Anhui	Bengbu
126	Micro display product series	Electronics and information	Anhui	Wuhu
127	Encoded microwave anti-theft alarm system	Electronics and information	Fujian	Fuzhou
128	1/4 inch data-flow magnetic tape drive	Electronics and information	Fujian	Xiamen
129	TRS5412 thick-membrane integrated switch voltage-stabilization circuit	Electronics and information	Fujian	Xiamen
130	Farad-level large-capacity capacitor	Electronics and information	Fujian	Xiamen
131	UPS AC sine-wave non-intermittent power-supply system	Electronics and information	Fujian	Zhangzhou
132	CLZ three-coordinate measurement device	Electromechanical integration	Fujian	Putian
133	Samarium-cobalt permanent magnet material	New materials	Fujian	Changting
134	Chloro-polyaromatic-sulphone synthetic-fiber resin and reeled silk	New materials	Jiangxi	Yichun
135	Lithium tantalate monocrystals	New materials	Shandong	Jinan
136	Pharmaceutical carbon platinum for cancer therapy	Biotechnology	Shandong	Jinan
137	Complex enzyme for improving tobacco quality	Biotechnology	Shandong	Jinan
138	Electronic ceramic components series for color TV	Electronics and information	Shandong	Jinan
139	35 tons/hour cycle fluidized bed boiler	High efficiency and energy conservation	Shandong	Jinan
140	Blood microcycle comprehensive parameter tester	Biotechnology	Shandong	Qingdao
141	FX-101 single-guide miniature electrocardiogram machine	Biotechnology	Shandong	Qingdao
142	Textile-printing waste-water treatment flocculant and system	Other	Shandong	Qingdao
143	PTC (positive temperature coefficient) semiconductor material	New materials	Shandong	Zibo
144	5.5QD320 oil-submersible electric pump	High efficiency and energy conservation	Shandong	Zibo
145	Laser polarization product series	Electronics and information	Shandong	Qufu
146	BF three-layer fluoridated material	New materials	Shandong	Rongcheng

II. 1989 National-Level Torch Plan Projects (Continued)

147	Magnetic powder adhesive for magnetic disks and tapes	New materials	Henan	Zhengzhou
148	Polysulfide sealing rubber	New materials	Henan	Zhengzhou
149	Integrated ground-air transceiver	Electronics and information	Henan	Xinxiang
150	Bonded nickel-cadmium rechargeable battery	High efficiency and energy conservation	Henan	Xinxiang
151	Marine-structure protection material	New materials	Henan	Luoyang
152	JGC-1 online laser thickness-measurement device	Electronics and information	Henan	Zhumadian
153	Foil-type energy-conserving electric welder	High efficiency and energy conservation	Henan	Yanling
154	Carrier-wave telephone single-signal crosstalk tester	Electronics and information	Henan	Nanyang
155	Polytetrafluoroethylene	New materials	Hubei	Wuhan
156	High-purity silicon-oxide, aluminum-oxide, and lead-oxide powder material	New materials	Hubei	Wuhan
157	Plasma-prepared ultrafine antimony white powder	New materials	Hubei	Wuhan
158	High-performance zirconium oxide ceramics	New materials	Hubei	Wuhan
159	Enzyme-method production of para-hydroxy benzoglyceric acid [?] and benzoglycine	Biotechnology	Hubei	Wuhan
160	Anti-human-T-lymph cell and subgroup monoclonal antibody	Biotechnology	Hubei	Wuhan
161	Digital fiber-optic communications terminal equipment	Electronics and information	Hubei	Wuhan
162	F8500 industrial-controller automatic-mixing monitoring and control system	Electromechanical integration	Hubei	Wuhan
163	JH3100 electric-breakdown device	Other	Hubei	Wuhan
164	High-efficiency livestock terramycin calcium salt	Biotechnology	Hubei	Yichang
165	5.5-inch micromonitor	Electronics and information	Hubei	Yichang
166	Oil-field oil-extraction parameter logger	Electromechanical integration	Hubei	Shashi
167	High-voltage-grid power-factor microcomputer automatic compensation equipment	High efficiency and energy conservation	Hubei	Shashi
168	IPN broad-temperature-range damping material	New materials	Hubei	Huangshi
169	Ferric-oxide magnetic powder for use in magnetic tapes	New materials	Hubei	Huangshi
170	ZnB non-toxic fire retardant	New materials	Hubei	Suizhou
171	Thermal isostatic pressure manganese-zinc-iron oxide magnetic head material	New materials	Hubei	Xishui
172	High-efficiency germicide for use in detergents	Other	Hubei	Xiangfan
173	Microcomputer program-controlled laser optical-fiber surgery device and oxyhemograph	Electronics and information	Hubei	Xiaogan
174	Numerically controlled crankshaft neck-grinding machine and numerically controlled crankshaft connecting-rod neck-grinding machine	Electromechanical integration	Hubei	Xiaogan
175	Micron-level stainless steel fiber	New materials	Hunan	Changsha
176	Seven-coordinate numerically controlled Ni Zhifu drill grinding machine	Electromechanical integration	Hunan	Changsha
177	"One-cyanogen" synthetic dispersion dye, cold-dyeing dye, and organic color	Other	Hunan	Xiangtan
178	Antimony-copper-alloy material and products	New materials	Hunan	Yiyang
179	Rectangular automobile front illumination anti-dazzle bulb product series	Other	Hunan	Yiyang
180	DZR electronic new thermoelectric heating material	New materials	Guangdong	Guangzhou
181	Highly corrosion-resistant zinc-aluminum-rare-earth-alloy plating material	New materials	Guangdong	Guangzhou
182	Magnetic powder for magnetic recording	New materials	Guangdong	Guangzhou

II. 1989 National-Level Torch Plan Projects (Continued)

183	Special magnetic materials made with a high-efficiency centrifugal extractor	New materials	Guangdong	Guangzhou
184	Medical microcycle image-processing and parameter-testing system	Biotechnology	Guangdong	Guangzhou
185	S-band microwave cancer diagnosis machine	Biotechnology	Guangdong	Guangzhou
186	Cellular mobile telephone network wireless telephone	Electronics and information	Guangdong	Guangzhou
187	High-efficiency energy-conserving electronic lamp	High efficiency and energy conservation	Guangdong	Guangzhou
188	Vortex compressor	High efficiency and energy conservation	Guangdong	Guangzhou
189	Red-mold pigment	Biotechnology	Guangdong	Shenzhen
190	Microbiological pesticide—Suyunjin bacillus	Biotechnology	Guangdong	Shenzhen
191	Optical-fiber-sensor concentration tester	Electronics and information	Guangdong	Shenzhen
192	SEK-2350/2360 super minicomputer	Electronics and information	Guangdong	Shenzhen
193	Gamma-ray radiation sterilization therapeutical product series	Other	Guangdong	Shenzhen
194	Unicellular protein	Biotechnology	Guangdong	Jiangmen
195	Nine-pin printer	Electronics and information	Guangdong	Jiangmen
196	Third generation nickel-cadmium battery	High efficiency and energy conservation	Guangdong	Jiangmen
197	Industrial system simulation and control equipment	Electronics and information	Guangdong	Zhuhai
198	Computer hard-disk aluminum substrate	Electronics and information	Guangdong	Zhuhai
199	Repeated-addition Chinese-character high-density compression-technology products	Electronics and information	Guangdong	Zhuhai
200	High-speed graphics and text facsimile machine	Electronics and information	Guangdong	Zhongshan
201	Multi-function video telephone system	Electronics and information	Guangdong	Zhongshan
202	Limulus reagent	Biotechnology	Guangdong	Zhanjiang
203	New high-efficiency solar-energy water heater	High efficiency and energy conservation	Guangdong	Shantou
204	Multi-anti-thyroid [?] factor	Biotechnology	Guangdong	Dongguan
205	Computer hard magnetic disk	Electronics and information	Guangdong	Dongguan
206	Renal dialysis and blood dialysis machine	Biotechnology	Guangdong	Foshan
207	High-hardness artificial diamond	New materials	Guangxi	Guilin
208	Dual-axis directional polyimide membrane	New materials	Guangxi	Guilin
209	Digital communications optical channel	Electronics and information	Guangxi	Guilin
210	Optical-fiber video-transmission integrated services system	Electronics and information	Guangxi	Guilin
211	XA-FAX22 high-speed facsimile	Electronics and information	Guangxi	Guilin
212	Printed-winding servomotor product series	Electromechanical integration	Guangxi	Guilin
213	Elevator microcomputer-controlled equipment and emergency system	Electromechanical integration	Guangxi	Guilin
214	Organized culture and rapid breeding of red bananas and green-skinned pineapples	Biotechnology	Hainan	
215	Microcomputer MIM multifunction industrial-control modular system	Electronics and information	Hainan	
216	3.5-inch magnetic floppy disk	Electronics and information	Hainan	
217	PC computer teletype function board	Electronics and information	Hainan	
218	High-luminance, high-stability, long-life lanthanum hexaboride cathode	New materials	Sichuan	Chengdu
219	Wireless mobile communications equipment	Electronics and information	Sichuan	Chengdu

II. 1989 National-Level Torch Plan Projects (Continued)

220	Ultrasonic strata processing system and sound-wave oil-extraction vehicle	Electromechanical integration	Sichuan	Chengdu
221	Optoelectronic components used for infrared control	Electronics and information	Sichuan	Chongqing
222	High-performance heat-resistant polythio-ether resin	New materials	Sichuan	Zigong
223	XKFM716 numerically controlled copying milling machine	Electromechanical integration	Sichuan	Zigong
224	Vehicle engine servo system electronic controller	Electromechanical integration	Guizhou	Zunyi
225	High-resolution color display tube deflecting coil	Electronics and information	Shaanxi	Xi'an
226	Portable X fluorescence analyzer	Electronics and information	Shaanxi	Xi'an
227	FTCC-80X fault-tolerant computing	Electronics and information	Shaanxi	Xi'an
228	Full duplex decentralized-control multitasking communications network equipment	Electronics and information	Shaanxi	Baoji
229	Carbon/carbon composite aircraft brake material	New materials	Shaanxi	Xingping
230	Pa-Pt precious-metal catalyst	New materials	Gansu	Lanzhou
231	Artificial mechanical heart valve membrane	Biotechnology	Gansu	Lanzhou
232	LSK ion-beam sculpturing equipment	Electronics and information	Gansu	Lanzhou
233	Microporous-nickel-foil high-efficiency cadmium-nickel storage battery	High efficiency and energy conservation	Gansu	Tianshui
234	Niobium pipe and niobium-zirconium pipe	New materials	Ningxia	Shizuishan

All interested circles in China and foreign countries are invited to invest and cooperate in the above projects. Interested parties should contact the State Science and Technology Commission Torch High-Technology Industry Development Center.

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Hopes for Sino-Brazilian Third World Aerospace Group

40080230 Hong Kong LIAOWANG [OUTLOOK WEEKLY] (Overseas ed.) in Chinese No 32, 7 Aug 89 pp 24-25

[Article by Wang Zhigen [3769 1807 2704]: "Willing To Form Third World Space Group With China—A Visit to Brazil's Aeronautics and Space Industry Company"; see also FBIS-CHI-89-151, 8 Aug 89, p 8]

[Text] On 15 June 1989, the China Great Wall Industry Corporation (CGWIC) and Brazil's Aeronautics and Space Industry Corporation (Avibras) announced a joint investment to establish the "International Satellite Communications Corporation" for joint development of space technology. With this, China and Brazil have entered the realm of incisive technical cooperation and created a new milestone in economic and technical cooperation between the two countries. Brazilian newspapers published several editorials which pointed out with satisfaction that "cooperation between two large Third World nations will break the monopoly of the developed nations over international space technology."

At the invitation of the Avibras board of directors and accompanied by Chinese entrepreneur Mr Zheng Kai [6774 6963], reporters visited this world famous astronavigation company.

I. Vanguard of Latin America's Astronavigation Industry

Some 100-plus kilometers east of Sao Paulo, we arrived at Sao Jose dos Campos City, Brazil's "Technology Capital." Avibras is located at the northern end of the city, near the Brazil Aeronautics Industry Company and National Institute for Space Research (INPE), which sit back in a rich tropical forest. After the required security inspection at the gate, we drove onto the huge company grounds. The 5-star red Chinese flag, the Brazilian flag, and the company banner were flying from the flagpole in the center of the grounds. Brazil's space research originator and Sino-Brazilian "International Satellite Communications Corporation" executive director Professor Fernando Mendoza and Avibras director and business department general manager Pedro Weyer [spelling of surname uncertain] and others waited under the flags to welcome their guests. This solemn occasion gave one the deep impression that the people of Brazil had excellent hopes for cooperation with China.

The friendly leaders led reporters into a company conference room and began by introducing a video of main products in the history of the corporation's development and then took reporters to a product exhibition hall.

Avibras was founded by Brazilian entrepreneur Mr Joao (Wei'erdi Laite) in 1961, so it is a private corporation with a 28-year history. Over the past 28 years, it has

constantly been involved in research on advanced aeronautic and aerospace technology, and it is the astronavigation industry vanguard of Brazil and all of Latin America. Shortly after it was established, it focused on design and production of education and training equipment, but soon began to develop and produce Brazil's first sounding rockets and made a decisive contribution to Brazil's plans for aerospace development. The corporation signed a contract with the Brazilian Air Force and independently designed and manufactured the "Explorer 1," "Explorer 11-13," and "Explorer 11-C" sounding rockets. Not long afterward, it also developed and produced Brazil's first 4-meter-diameter meteorological radar antenna. Over the past few years, it has successfully developed a 10-meter-diameter satellite communications ground antenna and raised Brazil's space technology to a new level, moving it into the ranks of the world's eight largest satellite antenna producers. The corporation also produces solid propellants, telemetry systems, automatic goniometers, satellite navigation receivers, space photography timers, ground-station electronic equipment, radar antennas and mounts, microwave converters, and other space high-technology products. The satellite communications antennas and ground receiving stations produced by the corporation are used in conjunction with a satellite communications network launched jointly by the United States "International Communications Satellite" [Intelsat] and the Brazil Satellite Corporation to provide full coverage of Brazil's territory.

The international realm of Avibras is also advancing by leaps and bounds and making outstanding achievements by supplying advanced weapons to the armed forces of Brazil and friendly nations. The air-to-ground and ground-to-air weapons systems they import and produce have greatly strengthened Brazil's defense capabilities. They can produce short-range, medium-range, and long-range multi-tube rocket guns. The "ASTROS-11" multi-tube rocket gun can fire all different types of rocket shells for a maximum range of 60 km. They can be operated using regular rocket-control systems as well as radar rocket-control systems. All the systems (multi-tube rocket launcher frame, shell loaders, rocket control, electronic and mechanical auto-control maintenance, and radar fire control) use the same mount on an armored car. It has been acknowledged as a superior multi-tube rocket gun system with excellent performance and a wide range of uses which has been tested in war. In 1987, the company's munitions exports totaled $322 million (Brazil's total munitions exports during 1987 were $369 million), surpassing total munitions exports for the four countries of Israel, Yugoslavia, Spain, and Czechoslovakia, and making it Brazil's biggest private company in export volume and the world's ninth largest munitions exporter.

II. China and Brazil Can Establish a Third World Space Group

Avibras now has three large plants and four subsidiary companies with a total of more than 7,000 employees. Mr Pedro Weyer said "China's achievements in the aerospace realm have been acknowledged by the world. Brazil and China should and can form a Third World Group to break the monopoly of United States and West European groups in the realm of space technology."

The famous space expert Professor Mendoza continued by pointing out that "this is the goal of the joint establishment of the International Satellite Communications Corporation by Avibras and CGWIC." He said: "I worked for 20 years at NASA in the United States. I know that China has outstanding space experts while Brazil also has skilled people in this area. By joining together, the Sino-Brazilian joint investment company will be able to compete with and compare with NASA in the United States and Europe's Joint Aerospace Industry Corporation."

Professor Mendoza described the construction process and necessity of the Sino-Brazilian joint venture. He said that growth of the world's communications industry has made it increasingly urgent that all nations depend on and require satellite communications. Many countries have established satellite communications groups, including the United States-Canada group, West European group, and Soviet-European group, which hold a predominant and monopoly position in international markets. Third World nations like Indonesia and the Arab countries also have established their own groups. However, their lack of technology has compelled them to purchase materials from developed-nation groups and kept them under technological control for a long time. A small country wanting to develop satellite communications must spend enormous sums to buy large satellites from developed nations, creating enormous economic waste. The Sino-Brazilian "International Satellite Communications Corporation" was born in the midst of this contradiction and will search for avenues and strive for development from within this contradiction.

He said China has advantages in the areas of launching and manufacturing satellites while Brazil has advantages in the area of producing ground receiving systems and experience in business marketing and information processing. The two countries joined together to establish a complete space technology system, and as a result Brazil began contacts with China at the end of 1986 to explore the feasibility of cooperation. The "International Satellite Communications Corporation" mainly supplies clients with launch and ground receiving equipment, and designs and launches communications satellites for clients. It is a private commercial enterprise which can employ highly effective management principles to provide design and launch services and market the products of CGWIC and Avibras, and it will use a flexible management pattern for barter trade with several clients.

He said that the goal of the two countries' joint venture is for Third World nations to compete in the market with United States and European aerospace companies. Satellites and rockets handled by the new corporation are inexpensive and can be supplied quickly, a situation

superior to that in the United States and Europe. We are confident that we will launch nine satellites in 1994 and gain 10 percent of the world market.

Professor Mendoza said in closing: "The Chinese people have produced many outstanding scientists in the past. Chinese scholars can be found in all parts of the world, and China itself has trained thousands of experts. I used to work with several Chinese scholars in the United States. They were intelligent and hard-working, and all of them had made achievements in their professions. Now, I am cooperating once again with Chinese scholars and feel extremely happy and full of confidence. China's policy of opening up over the past several years has allowed China to develop in all realms. I firmly believe that China will adhere to this policy, so we are unwaveringly maintaining our cooperative relationship with China. There are broad prospects for cooperation in the economic and S&T realms for China and Brazil."

CAMAC Technology Improves Accuracy of Missile, Rocket Launches

40080240b Beijing RENMIN RIBAO [PEOPLE'S DAILY] (Overseas Edition) in Chinese 5 Sep 89 p 4

[Unattributed article: "In China's Space Monitoring and Control Technology, the Latecomers Surpass the Old-Timers; Improvement in Missile Launch Accuracy, Great Improvement in Actual Combat Ability"]

[Summary] Beijing, 4 Sep (ZHONGGUO XINWEN SHE)—Computer automated measurement and control (CAMAC) technology, widely applied in China's national defense over the eighties, has contributed to the successful launch of 22 strategic and tactical missiles, boosters and satellites, indicating that the technological level of China's ground monitoring and control systems for launching vehicles into space has advanced to the world's forefront. This technology involves a general-purpose internationally standardized interfacing system for computer-automated measurement and control, data acquisition and processing, data transfer and communications. Currently, over 20 countries—including the U.S., the Soviet Union, Japan, the FRG, France, and the U.K.—use this system standard.

China's CAMAC standardization project, initiated in 1980 by General Zhang Aiping, bore fruit after 3 years, when it produced results in seven areas of astronautical systems; launch time was reduced, launch accuracy was improved, successful missile launch rate was raised to 95 percent, and actual combat ability was greatly increased. CAMAC technology has also been applied in China's aeronautical, atomic energy, high-energy physics, metallurgical, electric power, and petroleum industries.

To promote the development of China's CAMAC technology and international exchange, China's Ministry of Aeronautics & Aeronautics Industry and Poland's Atomic Energy Commission are jointly sponsoring the "CAMAC89 International Conference" in Beijing in early September.

Nation's Space Technology Is Focus of Great Interest

40080234a Beijing RENMIN RIBAO (OVERSEAS EDITION) in Chinese 30 Aug 89 p 4

[Article by reporters Zhuo Peirong [0587 1014 2837] and Jiang Zaizhong [1203 0961 1813]]

[Text] Beijing, 29 Aug (XINHUA)—After more than three decades of struggle and hard work, China's space technology and space industry are taking shape. In particular, rapid progress is being made in space applications, and numerous achievements in the areas of remote sensing, satellite communication and micro-gravity science are the focus of attention in the space community.

Space applications cover a wide range of different topics. They refer to the multi-discipline activities in space exploration and applied research and development using satellites, aircraft, sounding rockets and high-altitude balloons as carrier vehicles.

On this day, the director of the Basic Research and High Technology Office of the State Science and Technology Commission, Ma Junru, described for us China's achievements in the following three areas of space applications.

In the area of remote sensing, we have developed a complete line of key components and equipment for weather satellite receiving systems, satellite earth stations, and airborne remote sensing system capability. A number of remote sensors developed by this country are considered to be state-of-the-art. Significant progress has been made in software development for image processing and geographic information systems. Airborne or spaceborne remote sensors have played an important role in wide-area surveys of natural resources and the environment; they also have potential applications in monitoring the movement of major storms and in estimating construction costs of engineering projects. The use of remote sensing has already produced good results in resource exploration and urban planning. In flood prevention, remote sensing would allow decision makers in a Beijing office to monitor the flood conditions in real time.

In the area of satellite communications we have developed the capabilities in satellite television broadcast, satellite-based education network, and satellite-based voice communication and data links. China's satellite communications has progressed from the experimental phase to the operational phase. During the coming year, the number of satellite TVRO stations will increase to 15,000 and 40 earth stations will be constructed for satellite communications. A comprehensive plan has been established for testing the communication links between small earth stations; implementation of this plan will make satellite communications an important means of information exchange for China's economic development. In addition, a cooperative effort with the United Nations to further explore applications of satellite communications is well under way.

In the area of micro-gravity science, we have constructed China's first special experimental facility. By making use of the three space flights of our own retrievable satellites, we have successfully produced high-quality galium-arsenide and indium-antimonide crystals, and have conducted heat-treatment experiments on super-conducting materials. In biological experiments, we have obtained first-hand data on the mutation and transformation of plants and micro-organisms under micro-gravity and space-radiation conditions. In the area of human life science, ground-based experiments have been successfully conducted under simulated conditions.

A Visit to the Jiuquan Satellite Launch Center

40080234b Beijing RENMIN RIBAO (OVERSEAS EDITION) in Chinese 4 Sep 89 p 4

[Article by Reporter Su Binshan [5685 2363 0810]]

[Text] In the foreseeable future, a new city may appear on the map of the People's Republic. It is the Jiuquan Satellite Launch Center, also known as Aerospace City. It is located on the western rim of the Badain Jaran Shamo, a part of the Great Gobi Desert. In recent years, as a result of China's reform and open-door policy, the mystic curtain of the launch center is gradually being lifted.

Construction of Aerospace City began in 1958. At that time, this was a completely uninhabited, desolate region. Over the past three decades, the constant struggle and hard work of several generations has created a well-equipped test facility. This facility is capable of conducting tests on missiles, nuclear weapons, long-range launch vehicles as well as artificial satellites and retrievable satellites. So far, a total of 19 satellites have been successfully launched from this center; the number of test launches of launch vehicles, strategic and tactical missiles is approaching 1,000, with a success rate of 87 percent. In the impact region of this test facility, the missions of search, retrieval and re-entry of more than 100 missiles and launch vehicles have also been completed.

This reporter had the opportunity to visit Aerospace City early this fall.

The people of Aerospace City are very proud of their outstanding achievements which have contributed to the rapid growth of China's aerospace industry: on 10 September 1960, a short-range ballistic missile powered by Chinese-made rocket fuel was successfully launched; on 4 november 1960, China's first surface-to-surface missile was successfully launched; on 27 October 1966, a missile carrying nuclear weapons was successfully tested; on 24 April 1970, China's first artificial earth satellite, "EASTIS RED," was successfully launched; on 26 November 1975, China's first retrievable satellite was successfully launched; on 18 May 1980, the first long-range launch vehicle was successfully launched toward the Pacific impact area; in September 1981, three satellites carrying scientific experiments were launched by a single launch vehicle; in August 1987, the "Long March 2" launch vehicle was used for the first time to provide launch service for a foreign company.

The first thing that came into view as I entered Aerospace City was the launch tower. This 55-m giant steel structure is the symbol of Aerospace City; it can be seen 20 km away as one approaches the launch center. The next day, accompanied by the head of the Technology Department, Zhang, I visited the launch tower. Zhang told me that of the 25 satellites launched by this country, 19 were launched from this tower; he also pointed out that this was where several hundred missile tests were conducted.

Inside the test and assembly building located in an area called zone No. 7, a "Long March-2" rocket was seen lying on the floor of the spacious and brightly-lit hall. The host explained to me that when the launch vehicle and the satellite arrive at Aerospace City, they are first placed in a horizontal position in this building where tests and inspections are performed. Before they can be transferred to the launch tower, the test results must show that all requirements have been met. In this building, many generations of engineers and technicians have contributed their sweat and blood for the launch center; for example, an elderly engineer whom we met today, Jin Chunpu, had just returned from the hospital after removing three-quarters of his stomach to teach the young engineers his experience on calibrating measured ballistic missile data.

Many of these pioneers not only gave their sweat and blood, but also sacrificed their lives. In the "Dongfeng Memorial Cemetery", the accomplishments of the early pioneers and developers are recorded on more than 490 tombstones. These pioneers included commanders, soldiers, scientists and engineers, and support personnel. On one of the tombstones was the name of an engineer, Hu Wenquan. Hu was one of the first pioneers of Aerospace City; he worked like a machine which ran continuously for 29 years. Unfortunately, on the eve when Aerospace City was opened to the outside world, he was taken away from his beloved career.

Aerospace City has a complicated organizational structure which is divided into more than 50 units; each unit is given an assignment which is kept secret from other units. It was explained to us that each missile or satellite has both an active and a passive safety control system. The responsibilities of the safety control officer are twofold: first, he must carefully inspect all onboard instruments to ensure that they are functioning properly; second, in case a malfunction of the missile or satellite develops during flight and the onboard control system also fails, then he must issue a radio command to cause the missile or satellite to be destroyed at the appropriate time. Therefore, the safety control officer has a grave responsibility on his shoulder; any misjudgment on his part will result in unmeasurable loss to the mission. When asked about the possibility and the consequence of misjudgment, an engineer replied: "In a situation like this, one simply cannot afford to make any wrong decision." During the "cultural revolution" era, there was an incident where a malfunction developed shortly after launch, and the safety control officer decided to push the control button and destroyed the rocket. However, some people felt that his action was politically motivated and demanded an investigation. Fortunately, the data recorder clearly showed the evidence of rocket malfunction and the time of destruction, which saved this comrade from persecution.

The area referred to as zone No. 10 is also called the Dongfeng Downtown area. Here, we paid a visit to the Security Bureau. In terms of security affairs, this bureau is under the jurisdiction of the Security Department of Gansu Province; it is in charge of such functions as maintaining order, criminal investigation, transportation, and resident registration. It also has a team of firemen and traffic policemen. However, all personnel of the Security Bureau are military officers who are part of the Jiuquan Launch Center organization. Bureau Chief Zhang Bingheng, who was recently promoted to the rank of colonel, told us that all police officers of the Security Bureau are selected military personnel who had participated in police training at the Police Academy before taking their respective posts. He also said: "With the growth of the Launch Center, we are encountering an increasing number of social problems which cannot be handled by the department of military affairs or military police. It is clear that a local government must be established." The Security Bureau is one of the organizations of this government; in addition, the Launch Center also has a courthouse and a prosecutor's office, whose staff members are also military personnel. On the day following this reporter's visit to the Security Bureau, a trial was held for a robbery case. Because this government has a reputation of being a "military government," very few serious crimes have been committed. Bureau Chief Zhang is very happy about the situation; he said: "This is a law-abiding city, and our police officers are all very dedicated."

Like other Chinese towns, Aerospace City provides the necessary social services to its residents. The Dongfeng Shopping Center is well stocked with merchandise which are generally in great demand in inland China. Behind the Dongfeng Shopping Center is a secondary food market and a sizable free market. Across from the Shopping Center are the Post Office, the Bank, the Xinhua Bookstore, the Athletic Hall, a movie theater, a swimming pool, and a television station.

In the evening, as we strolled down Chang-an Street, the unbearable desert heat was swept away by a cool, moist breeze brushing over my face. This change in climate was the result of tree-planting projects of many past generations who considered tree-planting as one of the essential conditions for survival. Over the past three decades, more than 1,200 mu of segmented forests and 1,000 mu of desert-containment forests have been planted.

The development of Aerospace City is continuing. While there are still military camps around the city, it will undoubtedly evolve into a beautiful and attractive place like the new city of Daqing. As China's aerospace industry continues to grow, one day this city will become the focus of attention around the world.

Fujian Computer Society Holds Computer Virus Lectures

40080001 Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 33, 30 Aug 89 p 1

[Article by You Long [1429 7893]: "Fujian Province Computer Society Seeks to Allay Members' Worries on Eradicating Viruses"]

[Text] Just as a computer "ball virus" [see JPRS-CST-89-014, 18 Jul 89, pp 46-47, and JPRS-CST-89-022, 10 Oct 89, pp 10-13, 16-18 for description and analysis of virus] was spreading within the province, the Fujian Province Computer Society—concerned that its members were worried about the virus—held a series of special technical lectures in Fuzhou in early July on the topic of computer virus analysis. These lectures covered computer virus processes such as booting, infection, activation, and outbreak, as well as diagnosis and treatment methods, and provided anti-virus programs so that members' worries about "detoxification" could be addressed in timely fashion. Also, at the [Fujian] Province Computer Society board of directors meeting held in early July in Sanming, arrangements were made for special reports on the state of computer virus analysis in order to arouse the attention of relevant authorities, computer specialists and professors toward computer viruses.

Breakthrough in Soft X-Ray Laser Research Reported

40080002 Shanghai WEN HUI BAO in Chinese 8 Sep 89 p 1

[Article by Wang Lin [3769 3829]: "China's X-Ray Laser Research Reaches Advanced International Level: Shanghai Institute of Optics & Fine Mechanics Reports Shortest Domestic X-Ray Laser Wavelengths—Breaking Through the 100-Angstrom Barrier and Demonstrating that China's Research in This Area Has Abundant Strength and Bright Prospects"]

[Text] The Laser Plasma Physics Laboratory of the Chinese Academy of Sciences' Shanghai Institute of Optics & Fine Mechanics (SIOFM) has reported a major advance in a critical leading-edge technology: X-ray laser research. Using the institute's 12# experimental apparatus under low-power operating conditions, SIOFM personnel achieved soft X-ray lasing of combination pumped lithium and silicon ions at [two] wavelengths that have broken through the 100-angstrom [or 10-nanometer] level. These are the shortest X-ray laser wavelengths heretofore achieved in domestic laboratories and constitute new laser spectral lines not yet realized elsewhere in the world. This achievement demonstrates that China's X-ray laser research has taken its place at the world's forefront.

X-ray laser research is a critical area of exploration in the U.S. Star Wars project [to develop] anti-ballistic-missile directed- energy weapons. As a new experimental tool, the research has many promising applications in several areas of science and technology, such as medicine, biology, microelectronics technology, and metallurgy. Since the U.S.'s successful experimental demonstration of a nuclear-explosion-pumped X-ray laser in 1981, major research units in several countries throughout the world have been involved in an intense competition in laboratory X-ray laser research. Experimental research into amplified-spontaneous-emission gain at soft X-ray wavelengths is the core of X-ray laser research in laboratories today, and up to now only the U.S., the U.K. and a few other nations have established a precedent of successfully testing specific physical pumping mechanisms and of demonstrating the feasibility of the technology.

The SIOFM [X-ray laser] project group, led by researcher Xu Zhizhan [1776 5267 1455] and comprised of a key team of young and middle-aged scientists, has since the early eighties set its sights on this advanced topic of worldwide interest. As early as 1981, the research group achieved population inversion at soft X-ray wavelengths—an achievement formally cited in a treatise written by noted X-ray laser scientists from the U.S.'s [Lawrence] Livermore [National] Laboratory as being a major advance in the development of X-ray lasers. Under the leadership of Xu Zhizhan, the research group in the past few years has been working on linearly focused high-power laser technology, and has developed several advanced diagnostic instruments such as an X-ray grazing-incidence grating optical spectroscope and an X-ray transmission grating optical spectroscope. Studying the characteristics of linear plasmas as a medium for X-ray laser gain, they have realized several major achievements at an internationally advanced level. Examples include the first use of microimaging techniques to observe the phenomenon of filament splitting in linearly focused laser plasmas, the first use of optical probe techniques to observe various jet structures of plasmas, and development of 50-percent-size imaging optical probe diagnosis for painstaking examination of time-evolution processes of jet structures in linearly focused laser plasmas. These achievements have won a high degree of praise and commendation from the international laser physics community.

After Xu Zhizhan's project group for the first time in China obtained laser gain at 105.7 angstroms with combination-pumped lithium and aluminum ions in a small laser-driven apparatus at the end of 1988, they conducted a new experiment this year from 10 to 16 August in which they used the institute's laser 12# experimental apparatus in low-power operating conditions to achieve distinct soft X-ray laser gain with combination-pumped lithium and silicon ions at two transmission wavelengths—87.3 and 88.9 angstroms. These are the shortest X-ray laser wavelengths obtained to now in domestic laboratories; this breakthrough of the 100-angstrom barrier is a major step forward toward the quite valuable "water window" wavelength (23-44 angstroms) for X-ray lasers. Since this experiment under conditions of low power density produced two new X-ray laser spectral lines, it has all the more critical practical significance and demonstrates that China's X-ray laser research stands at the world's forefront and is truly original.

Within the past year, Xu Zhizhan's project group had two breakthroughs in a row in soft X-ray laser research: the principal testing instruments applied in their experimental research were independently designed and developed by the research group, and each target used in the experiments provided the anticipated spectral data, fully demonstrating the abundant strength and solid foundation of Chinese scientists in the field of X-ray laser research and presaging the enormous potential for developing China's already strong facilities for X-ray laser research.

Current State of Domestic Radar Countermeasures Technology

40080235c Beijing ZHONGGUO DIANZI BAO in Chinese 4 Aug 89 p 3

[Article by Li Zuxin [2621 4371 2450]: "Current State and Disparity of Domestic Radar Countermeasures Technology"]

[Text] China has gradually developed its domestic radar countermeasures technology to a considerable scale, from imitation to total design, as it makes advances in radar technology over the years. In the area of equipment development, there are more than 20 models of airborne

omnidirectional alarm devices, ground-radar surveillance equipment, ground-radar interference equipment and ship-based radar interference equipment. Some devices are being deployed in the field to contribute to the struggle against our enemies. Technically, digital transient-frequency reception technology, channelized reception technology and digital direction-finding technology have been widely applied. From the standpoint of architecture, tactical functionality and key-component standards, the technical level is comparable to that in other countries in the 1970s.

Compared to similar equipment made in other countries, major areas of disparity are in:

1. All existing radar countermeasure devices are single-unit, single-function devices operating in a specific band covering a narrow frequency range. They cannot deal with the whole-spectrum electromagnetic environment abroad and require manual combination.

2. We do not yet use computers and microprocessors for control, resulting in poor accuracy. Equipment does not have programmable functions and lacks fast-response capability against a new hostile radar signal.

3. Equipment does not have the power-control capability to concurrently operate in the deceptive-interference and clutter-interference modes and to simultaneously interfere with several targets.

4. Our products were not developed as a series, are not standardized and are not built with [economies of] scale. Therefore, they cannot be retro-fitted based on different requirements.

5. Our products have poor reliability, long maintenance and repair cycles and do not have any self-test capability. In order to shorten the gap and catch up with the world in a short time to meet the needs in the future, all research institutes and factories in China are conducting preliminary research activities into advanced areas of radar countermeasures technology in order to make technical breakthroughs.

Optical Thin-Film CAD/Monitoring System Developed

40080235b Beijing ZHONGGUO DIANZI BAO in Chinese 1 Aug 89 p 1

[Article by Li Qiongrui [2621 8825 3843]: "Breakthrough in Optical Thin-Film Design and Monitoring"]

[Text] There has been a new breakthrough in computer-aided design (CAD) and monitoring for optical thin films. This information was released at the "Optical Thin Film CAD/Monitoring Research" review meeting held by the 11th Research Institute of the Ministry of Machine-Building & Electronics Industry. According to experts, this research achievement of the 11th Research Institute changed the situation wherein optical thin-film fabrication design was ahead of monitoring, and design and monitoring were separated. Based on the review, this accomplishment has met several world-class specifications. Particularly, a multi-point (256 points) broad-spectrum curve can be displayed on a rapid and real-time basis.

Optical films are important elements in modern lasers and infrared optics. In an optical system, an optical thin film can serve several functions such as transmission, reflection, beam splitting and filtering. The fabrication of optical thin films involves very complex design and computation of the film system and also requires an extremely accurate monitoring technique to control the film thickness. For instance, the total thickness of an optical thin film operating in the visible spectrum may be less than 1 micron; the alternating deposition of several to scores of layers of different dielectric materials is required. In the coating process, the thickness of each layer is controlled within a few thousandths of a micron. The technical staff of the institute used new technology such as microcomputers and photodiode-array scanning, in conjunction with suitable software, to develop an integrated system for automated film design, film-thickness monitoring and film-spectrum measurement. In addition to having the capability to display a fast, real-time multi-point spectrum, it also can provide transmittance at a specific wavelength, evaluate different functions and store data on disk. The optical thin films prepared by this system have been used in an aerospace project with satisfactory results.

It is our understanding that this kind of research is also being carried out in the United States, Japan, France and Canada.

Schottky Barrier Infrared Focal-Plane-Array Device Developed

40080235a Beijing ZHONGGUO DIANZI BAO in Chinese 23 Jun 89 p 3

[Article by Yue Ziqiang [2867 1311 1730]: "Schottky Barrier Infrared Focal-Plane[-Array] Device Passed Review"; Note: for earlier report, see JPRS-CST-89-014, 18 Jul 89, p 70]

[Text] A Schottky barrier infrared focal-plane-array (FPA) device has been successfully developed at the Shanghai Institute of Technical Physics of the Chinese Academy of Sciences. Furthermore, it has been favorably reviewed.

A Schottky barrier infrared FPA device is a monolithic medium-infrared FPA device. Its manufacturing technology is compatible with that of the silicon VLSI (very large scale integration) technology. This device, whose advantages include higher pixel density and better uniformity between pixels, has been the focus of attention in a few developed nations. This novel compact, low-power, simple and rugged solid-state information processing device can effectively monitor the infrared emission characteristics of the target around-the-clock telemetrically. Therefore, its prospects in areas such as

infrared aerospace remote sensing, medical diagnostics, night vision, and geological prospecting are very promising.

The Schottky barrier infrared FPA device developed by the Shanghai Institute of Technical Physics employs the interline transfer architecture. It consists of two serial CCD arrays with 32 CCDs in parallel. All CCDs are four-phase driven. The pixel array is 32x64, and the individual pixel area is 62 microns x 62 microns. The substrate, which has a 30 percent filling efficiency, is P-type single crystal silicon. The platinum-silicide P-type silicon Schottky barrier was formed by high-frequency magnetron spattering.

Experimental Study of Li-Like Ion Soft X-Ray Laser

40090072a Shanghai ZHONGGUO JIGUANG [CHINESE JOURNAL OF LASERS] in Chinese Vol 16, No 7, 20 Jul 89 pp 385-388

[Article by Xu Zhizhan [1776 5267 1455], Zhang Zhenguan [1728 2973 3123], Fan Pinzhong [5400 0756 1813], Chen Shisheng [7115 2514 0524], Lin Lihuang [2651 4409 3552], Lu Peixiang [7120 1014 4382], Wang Xiaofang [3769 2556 2455], Qian Aidi [6929 1947 1229], Zhang Yanzhen [1728 3601 3791], Wang Lijun [3769 7812 0689], Sun Lan [1327 1526], Feng Xianping [7458 6343 1627] and Zhou Jinzhi [0719 6930 2535] of Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences]

[Abstract] At the Shanghai Institute of Optics and Fine Mechanics, soft X-ray laser gain experiments were successfully conducted with a six-path laser apparatus. By applying a one-dimensional space discrimination glancing incidence grating spectrograph (made in the authors' institute), the authors studied the amplifying properties of spontaneous emission (ASE) of Li-like ions of Al and Si in a plate (1 mm thick) target laser plasma. As shown in the experiments, the time integration emission intensity of the 5f-3d transition (10.57 nm wavelength) of Al10+ ions increases nonlinearly with length of linear plasma. The corresponding gain coefficient is 2.3 plus or minus 0.7 cm-1; the product of maximum gain lengths is approximately 2; as manifested in the space discriminating light spectrum, the region with the maximum gain is at about 440 m from the target surface.

Five figures show the time integration XUV light spectra of linear laser plasma at different lengths obtained with a 1-m glancing incidence grating spectrograph, the gain property curve, XUV spectra of aluminum laser plasma at different positions from the target surface, the spatial distribution of the 5f-3d transition spectral line intensity of Li-like Al ions, and the time integration XUV light spectra of linear Al plasma at different lengths.

The research was carried out with support by Professors Wang Daheng [3769 1129 3801], Chen Nengkuan [7115 5174 1401[, Wang Zhijiang [3769 0037 3068], Deng Ximing [6722 6932 6900] and Yang Guozhen [2799 0948 2823]. The authors are grateful to the staff at the High-Power Laser Physics Laboratory at the Shanghai Institute of Optics and Fine Mechanics for their assistance, and to professor-director Schafer of the Max-Planck-Institut fur Biophysikalische Chemie, West Germany, for supplying the authors with Kodak 101-01 films.

This research project was jointly supported by the State High Technology Fund, the State Natural Science Fund, and the Major Project Fund of the Chinese Academy of Sciences. The paper was received for publication on 11 March 1989.

Channeled-Mesa Substrate Three-Segmented Large Optical Cavity Structure Semiconductor Lasers

40090072b Shanghai ZHONGGUO JIGUANG [CHINESE JOURNAL OF LASERS] in Chinese Vol 16, No 7, 20 Jul 89 pp 402-406

[Article by Li Yudong [2621 3768 2639], Zhang Chongning [1728 1504 3942], Liu Shiyong [0491 1709 1066] and Gao Dingsan [7559 7844 0005] of Department of Electronics Science, Jilin University, Changchun]

[Abstract] The authors describe a novel laser design, a channeled-mesa substrate three-segmented large optical cavity structure (CMS-TSLOC) laser. This is a common-base optical three-segmented laser, fabricated by connecting both terminals of a mesa substrate laser with two channeled substrate lasers. By using different structures with a three-segmented cavity, different light limiting factors (gamma) are obtained; the gamma of the mesa substrate zone is larger than the gamma of the channeled zone. Thus, most lasers in the channeled zone can emit into the waveguide layer, thus broadening the light emitting area, reducing cavity surface attenuation, and enhancing the output efficiency. This kind of laser device has features of low threshold current, high output power and easily accessible operations of lateral fundamental mode and single longitudinal mode.

One table lists comparable data on the extension layer thicknesses of channeled and mesa zones. Eight figures show the structure and cross section of a CMS-TSLOC laser, its typical power current (P-I) curves, far (light) field diagram, continuous working (CW) P-I property with temperature, CW light spectra of single longitudinal mode, a wavelength versus temperature relationship for a CMS-TSLOC laser and laser spectrum, as well as the relationship between the light power limiting factor and waveguide layer thickness for the planar surface large optical cavity structure TE0 mode.

The authors are grateful to Su Shichang [5685 1102 2490], Zhang Shuzhi [1728 3219 5347], Zhang Yuxian [1728 3768 6343], Hu Lizhong [5170 4409 1813] and Jin Enshun [6855 1869 7311] for their assistance.

First draft of the paper was received on 3 April 1987; the final, revised draft was received for publication on 13 July 1988.

Optimized Waveguide CO2 Laser

40090072c Shanghai ZHONGGUO JIGUANG [CHINESE JOURNAL OF LASERS] in Chinese Vol 16, No 7, 20 Jul 89 pp 423-425

[Article by Liu Xijun [2692 1585 0193] of Institute of Physics, Academia Korea, Pyongyang; as well as Zhou Huifen [0719 1979 5358] and Wang Mingchang [3769 2494 1603] of Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences]

[Abstract] In the paper, the authors calculate the transmission and coupling attenuation of the EH11 waveguide mode in an internal-cavity, sealed-off type pyrex glass CO2 waveguide laser, as well as laser optimal transmissivity. On this basis, the internal-cavity, sealed-off type CO2 waveguide laser was designed and built. Discharge properties and equipment configuration of the laser are described. In addition, the authors discuss the relationship between discharge parameters and output power, as well as some experimental results. The average output power of the laser is 3 watts, with the maximum at 3.57 watts. The output power of the unit activation length and volume are, respectively, 0.27 watt per centimeter and 17.3 watts per cubic centimeter; the figures agree with the results in theoretical calculations. One table lists several Unm (m-th root of the n-th Bessel function) values. Five figures show the structure of the CO2 waveguide laser, output power versus discharge current curves, variation of laser output power with xenon content and atmospheric pressure, cooling effect of the discharge tube, and relationship between laser saturation intensity and atmospheric pressure.

The paper was received for publication on 20 July 1988.

BHA:Cr3+ Crystal Growth and Structure

40090072d Shanghai ZHONGGUO JIGUANG [CHINESE JOURNAL OF LASERS] in Chinese Vol 16, No 7, 20 Jul 89 pp 428-430

[Article by Pan Peicong [3382 0160 5115], Ma Xiaoshan [7456 4562 1472] and Hu Zhiwei [5170 1807 0251] of Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences]

[Abstract] The paper reports growth (for the first time) of BHA:Cr3+ (BeO.3Al2O3:Cr3+) crystals of relatively large dimensions. The technical conditions of this crystal growth are presented; the key factor of crystal growth is the constituents. Several crystal structures were tentatively determined. An iridium crucible was used in the experiments. The rotating speed of crystal was 100 rpm; the drawing speed was 3.8 mm/hr; and the furnace gas used was N2 during experimentation.

Three figures show the power curves recorded during the crystal growth process, temperature variation at the crucible bottom, effect on crystal growth of excess BeO in the constituents, and a BHA:Cr3+ large crystal with good appearance and transparency.

The research was supported by China's National Science Fund. The paper was received for publication on 1 July 1987.

Frequency Stabilized Ring Nd:YAG Laser

40090076a Shanghai ZHONGGUO JIGUANG [CHINESE JOURNAL OF LASERS] in Chinese Vol 16, No 8, 20 Aug 89 pp 449-451

[Article by Peng Kunchi [1756 1024 1062], Li Ruining [2621 3843 1380], Huang Maoquan [7806 5399 0356], Liu Jing [0491 2533], Jin Shaozheng [7246 1421 1767] and Li Jun [2621 6511] of Opto-Electronics Research Institute, Shanxi University, Taiyuan; and Zhou Shouhuan [0719 1108 2719] of North China Research Institute of Electro-Optics, Beijing (Institute Number 11), Ministry of Electronics Industry]

[Abstract] A frequency-stabilized high output continuously operating Nd:YAG laser is a very useful light source in studying nonlinear optical phenomena because it is comparatively easier to obtain stabilized single frequency outputs higher than 1 W. When the input power of the pumping light is 2.2 kW, the single frequency output obtained is 1.2 to 1.5 W; the long-term stability of frequency is less than 0.7 MHz; and the fluctuation of output intensity is less than 2 percent. As proven in experiments, the thermal insensitive operating point of the laser is consistent with theoretical calculations.

Six figures show a sketch diagram of the ring cavity, the thin lens sequence equivalence of a ring cavity, an experimental arrangement, the variation curve of relative output fluctuation versus input power of the pumping light, the frequency discrimination curve, and the transmitted intensities of a confocal cavity for the out-of-locking and locked states. The research is a project of the National Science Fund and the Shanxi Provincial Science Commission. The paper was received for publication on 14 December 1987.

Thermal Lens Effect and Its Compensation in High Power Laser Windows

40090076b Shanghai ZHONGGUO JIGUANG [CHINESE JOURNAL OF LASERS] in Chinese Vol 16, No 8, 20 Aug 89 pp 456-459, 455

[Article by Chen Qingming [7115 3237 2494] of Engineering Physics Department, Qinghua University; as well as Zhang Yongfang [1728 3057 2455] and Li Zaiguang [2621 0375 0342] of Laser Research Institute, Huazhong University of Science and Technology, Wuhan]

[Abstract] In the paper, first the Fizeau and Michelson interference methods are applied in dynamic two-dimensional thermal distortion studies of the operating

and out-of-cavity windows. Secondly, based on measurement studies of the near- and far-field distributions of a laser beam by using a two-dimensional scanning system, the thermal conductivity equations are solved.

Thus, experimental studies and theoretical analyses were made of the thermal lens effect of a GaAs and ZnSe output cavity lens. By using a concave output lens, the thermal lens effect is compensated, thus enhancing the beam quality of a high-power, fast-flowing, lateral electrically excited CO2 laser device. One table lists data of the optical path gain with rectangular coordinates, polar distance and radian. Four figures show convergence phenomena of laser window distortion to the output light beam, variation of beam quality with laser output power, light path gain measurements, and a comparison of light beam quality between a biconcave cavity with compensation and planoconcave cavity without compensation.

The paper was received for publication on 4 January 1988.

Study of a 20W XeCl Excimer Laser With High Stability and High Efficiency

40090076c Shanghai ZHONGGUO JIGUANG [CHINESE JOURNAL OF LASERS] in Chinese Vol 16, No 8, 20 Aug 89 pp 487-489

[Article by Yu Yinshan [0151 0692 1472], Wang Huasheng [3769 5478 0524], Li Guangyin [2621 1684 1377], Zhang Zhiping [1728 1807 1627] and Wang Jianye [3076 1696 2814] of Anhui Institute of Optics and Fine Mechanics (Hefei), Chinese Academy of Sciences]

[Abstract] The paper presents a practical type XeCl excimer laser of intermediate power, high stability and high efficiency. The laser's operating features are listed: maximum single pulse energy, 405 mJ; and highest average power, 31 watts. At different voltages, the conversion efficiency is higher than 1.4 percent with the maximum at 1.8 percent. For 106 repetitions of operating life tests with the operating voltage in the range of 22kV, the output power is maintained at 15 watts and the fluctuation is less than plus or minus 7 percent. Two figures show the variation of laser output power with voltage, and variation curves of laser energy (and efficiency) versus voltage.

The authors are grateful to Ni Jinzhi [0242 2516 2535] for his participation in several experiments, and to Hu Xiangkui [5170 0686 5525] for providing assistance with the measurements. The paper was received for publication on 14 November.

Experimental Study of Active-Passive Colliding Pulse Mode-Locked Nd:YAG Laser

40090076d Shanghai ZHONGGUO JIGUANG [CHINESE JOURNAL OF LASERS] in Chinese Vol 16, No 8, 20 Aug 89 pp 489-492

[Article by Wang Shijie [3769 0013 2638], Lu Haihe [7120 3189 7729], Li Shiying [2621 1102 5391], Chen Shisheng [7115 2514 0524], Lin Lihuang [2651 4409 3552] and Zhu Guoying [2612 0948 5391] of Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences]

[Abstract] The paper reports the experimental and study results of an active-passive, and a purely passive colliding pulse mode-locked Nd3+:YAG laser. The pulse width of the active-passive mode-locked laser is 15 picoseconds (ps); fluctuation of laser output pulse train energy is less than plus or minus 2 percent. The pulse duration of the passive mode-locked laser is 12 ps; the fluctuation in the pulse train energy is less than plus or minus 10 percent. By inserting a standard piece into the cavity, a mode-locked laser with its pulse duration varied between 15 and 26 ps is obtained. In experiments, the laser polarization properties of non-resonant ring cavity are studied. Seven figures show an experimental arrangement, the relationship between mode-locked pulse duration and pulse energy on the one hand, and dye transmissivity on the other, the effect of dye transmissivity on the duration and energy of passive mode-locked pulses, the duration of active-passive mode-locked pulses, active-passive mode-locked cavity-length-matched pulse envelope, active-passive mode-locked pulse envelope, and the effect after a standard piece was inserted into cavity.

The paper was received for publication on 30 August 1988.

First All-Chinese-Made DS4 Fiber-Optic Communications System Accredited

40080240a Tianjin ZHONGGUO JISHU SHICHANG BAO [CHINA TECHNOLOGY MARKET NEWS] in Chinese 5 Aug 89 p 2

[Article by Hu Hong [5170 1347]]

[Text] China's first all-domestically-made 140Mbit/s [DS4] single-mode optical cable communications system recently passed the acceptance check sponsored by the Ministry of Posts & Telecommunications at Wuhan. This fiber-optic line, jointly constructed by the Wuhan Institute of Posts & Telecommunications Science and by the Wuhan Municipal Telecommunications Office, is one of China's pilot projects in fiber-optic communications [see JPRS-CST-89-005, 23 Feb 89, p 84]. With a total length of 37 kilometers, the system employs microcomputer monitoring and control; radiated optical power and receiver sensitivity both surpass design requirements. In six months of trial operation, the system has demonstrably improved the critical situation involving Wuhan's municipal communications.

The completion of this project signifies that China's fiber-optic communications industry has entered a new stage of development.

35MeV Proton Accelerator Applied Project Passes State Acceptance

40080232a Beijing GUANGMING RIBAO in Chinese 5 Aug 89 p 1

[Article by Sang Hongchen [2718 3163 5256]]

[Text] The 35MeV proton linear accelerator and applied research project of the Institute of High Energy Physics of the Chinese Academy of Sciences, that took 5 years to build passes state acceptance today. This makes China one of the few countries in the world that possess this type of accelerator.

The 35MeV proton accelerator is an expansion of the 10MeV proton accelerator. It consists of four parts: the 35MeV beam, the medium energy beam transport system, the isotope laboratory, and the neutron cancer research laboratory. The total building area is 2,550 square meters. The state acceptance committee felt that the accelerator and the transport line are rationally designed and successfully built, installed and tested. The facility is of the advanced international standard. The isotope production, testing facility, and neutron cancer research facility have all met the design and applied research requirements. The radiation protection is safe and reliable, and the "three wastes" are disposed according to environmental regulations. Using this accelerator, thallium-201 isotope has been successfully produced and the mass of the isotope met the American pharmaceutical standard. Isotope carbon-11 produced in this accelerator has helped to produce good images in animal experiments of positron tomography. The neutron beam produced by this accelerator has sufficient energy and flux for cancer research using neutron. Fundamental research of nuclear physics and nuclear chemistry has also produced good results.

The completion of the 35MeV proton linear accelerator and applied project is led by the State Planning Council, the State Science Council, and the Chinese Academy of Sciences. It is the result of a coordinated effort of nearly 100 companies and research institutes. Based on incomplete statistics, about 50 new technologies and new materials have emerged in the course of building the accelerator. Also resulted from the accelerator project are more than 50 papers; among these six are published in foreign academic journals and three are read in international conferences.

State-of-the Art Control Technology Claimed as Positron-Electron Collider

40080232b Beijing RENMIN RIBAO in Chinese 15 Jul 89 p 2

[Article by Wang Youqi [3769 0645 7871], reporter for the Central People's Broadcast Station, and Hu Nianqiu [5170 1628 4428], reporter for Xinhua News Agency]

[Text] The control and measurement technology of China's positron-electron collider passed technical evaluation in Xi'an yesterday. The accuracy of the control network has reached advanced world standards.

Discovery of new elementary particles in positron-electron colliders is a leading method in today's high technology fields; it is possible in only a few countries. After China's positron-electron collider laboratory was established, it was discovered that more than 370 electromagnets, each weighing several tons, must be accurately positioned. An error of 0.2mm in the radial distance between two adjacent points is enough to affect the collision of the positron and the electron.

The 1st Brigade for Surveying and Mapping of the general staff was responsible for the control and measurement task. After working for 1 year, they settled on an optimum plan that kept the error of the horizontal control at only 0.05mm. This accuracy was much higher than the control standard and received an award from Premier Li Peng [2621 7720].

Chinese and foreign experts believed that the control and measurement technique discovered by the General Staff's 1st Brigade for Surveying and Mapping in their practice is invaluable for other priority projects.

Beijing Positron-Electron Collider Project Passes Appraisal

40080232c Beijing RENMIN RIBAO [OVERSEAS EDITION] in Chinese 6 Jul 89 p 4

[Article by Yang Lianghua [2799 5328 0553]]

[Text] The positron and electron collider and the Beijing spectrometer, representing the pinnacle of China's modern science and technology, have been successfully operated for more than 3000 hours. They passed the State evaluation today and their performance has reached the advanced level of the 1980's.

Appraisal committee Chairman Wang Ganchang was pleased to give his appraisal: After the atomic bomb, the hydrogen bomb, and the satellite, this is another one of China's major achievements.

The Beijing positron-electron collider is the largest construction project in China today and its construction will cost hundreds of million yuans. The high energy accelerator consists of the particle injector, the transmission line, the storage ring, the particle monitor and the synchrotron radiation group; it involves technologies of the 1980's. A hundred research institutes, universities, and industrial companies led by a dozen ministries used only four years to complete the project with high quality and low cost and put the facility into operation.

After days of testing, experts found that the peak intensities when the collider was operating at 1.6GeV and 2.2GeV energy ranges were respectively $2x10^{30}/cm^2$ sec and $7x10^{30}/cm^2$ sec. These have exceeded the design goals and are the highest intensities among similar

accelerators in the world. Other performance specifications have also met or exceeded the design targets. Since the Beijing spectrometer was put into operation, more than 20,000 charm particle incidences were observed and analyzed. Its principal design specifications were also met.

It was pointed out that the construction of the high energy accelerator and large particle detector in Beijing has made breakthroughs in some of China's industrial technology limits and put China's design and construction technology among the most advanced in the world. Technology promotion and application are also beginning to show economic benefits; some key components have entered the international market of high technology.

Scientists working in the accelerator laboratory think that the stable reliable operation of the Beijing positron-electron collider and spectrometer has paved the way for some world class research in high energy physics. Projects currently underway or to be launched are all in the frontier of high energy physics research and are very significant in advancing the understanding of the microscopic world.

The Impact on High Technology of the BEPC

40080223 Beijing WULI [PHYSICS] in Chinese
Vol 18 No 5, May 1989 pp 274-278

[Article by Ye Minghan [0673 6800 3352] of the Institute of High Energy Physics, Chinese Academy of Sciences, manuscript received in Nov 88: "The Beijing Electron Positron Collider Project"]

[Text] Abstract

This paper introduces the objectives and significance of the construction of the Beijing Electron Positron Collider, its primary engineering structure and its impact on China's industry and high technology.

I. Objectives and Significance

The Beijing Electron Positron Collider (BEPC) is a key national project in China. A collider is a high energy accelerator. In a conventional accelerator charged particles bombard a fixed target. In a collider, two beams of charged particles collide head on. The BEPC includes three main parts: (1) a collider, which consists of an injector, (i.e. a linear electron accelerator) and a storage ring capable of accelerating electrons and positrons to 28 GeV, (2) the Beijing electron spectrometer (BES), which is a large scale general purpose magnetic spectrometer equipped with a variety of particle detectors, and (3) synchrotron radiation beams and the associated experimental stations.

The BEPC was constructed to accomplished a multitude of objectives. The same device is going to meet the needs in basic and applied research. First, it will be used to conduct experiments in high energy physics. High energy physics is the study of the most fundamental structure of matters. It studies the mutual interaction and laws of motion of particles which are more fundamental and lower level than proton and neutron. History shows that although fundamental research very often seems not quite valuable at the time the study is conducted, yet it always benefits mankind tremendously without exception. For instance, when scientists began to investigate nucleus, it was pure basic research. However, the discovery of nuclear fission created a way for man to utilize atomic energy. Peaceful use of atomic energy and atomic weapons have drastically changed the world. High energy physics research conducted today will bring enormous benefits to mankind in the future.

The second objective is to utilize synchrotron radiation. When an electron or positron moves in a circle at high speed, it emits light at very high intensity. This is called synchrotron radiation. It has several advantages. Its spectrum is continuous and covers a wide frequency range, from visible light to X-ray. The flux is very high. The X-ray intensity is three to six orders of magnitude higher than that of a rotating target X-ray machine. It is highly collimated and has a specific time structure and is an ideal light source. Synchrotron radiation has been widely used in research and applications in solid state physics, surface science, life science, chemistry, chemical engineering, and microelectronics (lithography). There are 48 synchrotron radiation sources in the world which are either in operation or under construction or scheduled to be built (including multi-purpose facilities such as BEPC). There are six in third world countries, i.e. one each in Brazil, India and South Korea and three in China. In addition to BEPC, two lower energy accelerators dedicated to synchrotron radiation are being built, one in Hefei, Anhui (0.8 GeV) and the other in Hsinchu, Taiwan (1.3 GeV).

The third objective is to ultimately promote the development of new technology in industry. Based on other country's experience, development of high energy accelerators and high energy physics detectors usually leads to the development of a number of high technologies. The Western European Nuclear Research Center (Western European Center) located in Geneva, Switzerland is a high energy physics research center jointly funded by 14 European countries. Director Schopper of the center conducted a survey on the above subject. His conclusion is that every dollar invested in the center produces an average of three dollars in return to the industries in Europe from the high technology developed. There will be no exception for the BEPC. Some preliminary effect is already obvious and will be discussed in detail in section III.

The BEPC can also be used in free electron laser research. The synchrotron radiation research center (LURE) in Orsay, France is ready to conduct free electron laser research on their electron storing ring Super-ACO. In addition, the injector of the BEPC can accelerate electrons to 1.4 to 1.55 GeV. This kind of high energy electron can be used to conduct medium energy nuclear physics experiments. Or, it can be used to

produce a beam ofμ particles to conduct μ spin rotation (μSR) experiments. μSR is a physical probe to study condensed states.

In 1983 the BEPC project was approved by the Chinese government and listed as a key national project. The cornerstone was laid on 7 Oct 84. Hundreds of factories and research institutes under the jurisdiction of the Institute of High Energy Physics of the Chinese Academy of Sciences and a dozen or so ministries under the State Council, together with a large number of technical personnel, workers and management personnel of the Chinese Academy of Sciences, were united to work jointly on the development of a variety of equipment for this project. The project progressed swiftly according to plan. Electron positron collision was materialized on 16 Oct 88, more than two months ahead of schedule. It took only four years and ten days from laying its foundation to realizing collision. Compared this to the speed of construction of high energy accelerator elsewhere in the world, the normal speed is four to six years. Since this is our first, due to lack of experience, four years is a very short period of time.

II. Primary Structure

Figure 1 shows the schematic diagram of the BEPC. The injector is a linear electron accelerator (i.e. 1, 2, 3 and 4 in Figure 1). It is capable of accelerating electrons or positrons to 1.4 to 1.55 GeV. They are injected into the storage ring via the positron and electron transport line. The storage ring can accelerate electrons and positrons further to reach 2.8 GeV. After reaching their specified level, the energies of the electrons and positrons remain unchanged until they collide at a certain point (collision point). During collision, only a few electrons and positrons actually collide. Most of them are passing each other and continue to rotate in the ring. The number of electrons and positrons gradually decreases. After a few hours, it declines to a certain value (e.g. 30 percent). At this point, it requires another injection. The BEPC has two collision points. Because of budget limitation, only one of them is equipped with a large scale detector (i.e. the BES) to detect various particles produced as a result of an electron positron collison. Synchrotron radiation is drawn out of the storage ring from the III and IV quadrant.

1. Injector

The injector is a 200 m long linear electron accelerator and its principal parameters are listed in Table 1. It is divided into four major parts; (1) an electron gun; (2) the 30 MeV pre-injector, which accelerates electrons to 30 MeV; (3) the part that produces positrons and forms the positron beam, which accelerates electrons from 30 MeV to 150 MeV to bombard an removable positron target (tungsten) to generate positrons and to immediately focus them into a beam (when accelerating electrons, the positron target is removed to allow electrons to pass); and (4) the linear 1.4 GeV acceleration section which speeds up electrons or positrons to 1.4 to 1.55 GeV.

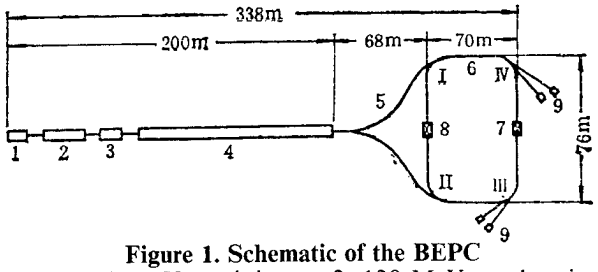

Figure 1. Schematic of the BEPC

Key: 1. 30 MeV pre-injector; 2. 120 MeV acceleration section; 3. Positron generation target; 4. 1.4 GeV positron electron acceleration section (1 through 4 constitute the injector); 5. Transport line; 6. Storage ring; 7. First collision point, the BES; 8. Second collision point; 9. Synchrotron radiation experimental stations

The accelerating structure (accelerator tube) employs an equi-gradient disk waveguide and each section is 3.05 m. There are 56 sections in total. The field in the accelerator tube is produced by microwave and the microwave frequency is 2856 MHz. A pulse width compression mechanism, an energy multiplier, is used in the microwave system to increase the peak power output of the klystron by approximately 50 percent.

Table 1. Major Parameters of the Injector

Item	Value
Electron/positron energy	1.4 - 1.55 GeV
Electron gun output pulse current	5 A
Positron, electron beam pulse width	2.5 ns
Positron, electron beam repetition rate	Tunable, maximum 50 times/s
Klystron operating frequency	2856 MHz
Klystron power (individual)	greater than 20 MW
Number of klystrons	16
Number of accelerating tubes	56
Degree of energy dispersion E/E	plus or minus 0.6 percent

The accelerating tube and energy multiplier were manufactured by the Institute of High Energy Physics. Their performance specifications are at world class level. The klystron, which is used to generate microwave power, was jointly developed by the Institute of High Energy Physics and Hanguang Electric Co. of the Ministry of Mechanical and Electrical Industry. The power output is approximately 30 MW.

The maximum injector energy has reached 1.55 GeV and the highest electronic current attained is 800 mA. Since it began to operate in Oct 87, it had accumulated over 5,000 hours of operation by the end of 1988.

2. Storage Ring

The major parameters of the storage ring are listed in Table 2. The ring is 240.4 m in perimeter and consists of two semi-circles and two 27.4 m linear sections. The

middle of the long linear section is a collision point. During injection, we inject energy into the ring. After electrons and positrons are first injected into the ring separately for storage, it begins to accelerate them simultaneously. The magnetic field is also strengthened in a synchronous manner. When the pre-determined energy level is reached, the magnetic field remains unchanged and electrons and positrons begin to collide.

Table 2. Major Parameters of the Storage Ring

Item	Value
Electron/positron energy	Maximum 2.8 GeV
Brightness (at 2.8 GeV)	$1.7 \times 10^{31}/cm^2.s$
Number cluster per beam	1
Beam current intensity	65 mA
Ring perimeter	240.4 m
Mean radius	37.9 m
Maximum turning magnet field strength	0.9028 T
Turning radius	10.345 m
	1.3 m
	0.1 m
Mean square root energy dispersion	7.4×10^{-4}
Mean square root cluster length	5.8 cm
Vertical mean square root cluster size	0.069 mm
Horizontal mean square root cluster size	0.89 mm
Frequency of radio frequency	199.53 MHz
Radio frequency power	200 kW
Synchrotron radiation power (per beam)	34 kW

There are a total of 40 bending magnets and the maximum magnetic field is 0.9028 T. There are 60 quadrupole (focusing) magnets and 8 magnetic quadrupole inserts near the collision point to focus the beams. In addition, there are four low field turning magnets at a maximum strength of 0.45 T and 32 six-pole magnets to compensate for the chromatic aberration introduced by the focusing system in the storage ring. The injector includes two iron dissectors, four static separators, and six impact offset plates. The vacuum chamber of the ring is made of aluminum and the beam passes a 56 mm high and 120 mm wide cross-section in the vacuum chamber.

The turning magnets were manufactured by the Xianfeng Electric Company in Shanghai. The quadrupole magnets were made by the shop at the Institute of High Energy Physics of the Chinese Academy of Sciences. The actual performance specifications of these two magnets are superior to the design requirements and have reached world class. The current stability of the electromagnet is better than one ten thousandth. There are two high frequency chambers in the ring. Charged particles are accelerated by the high frequency electric field as they pass by the chamber to reach the pre-determined energy level in a step-by-step manner. Afterward, the high frequency electric field only compensates the energy loss due to synchrotron radiation emitted by positrons and electrons to keep their energy levels constant. Each chamber employs four 25 kW high frequency transmitters in parallel to provide power input, which can reach 100 kW.

Energy and brightness are the two most important performance indicators for the storage ring. Brightness is propositional to the product of electron and positron current intensities. The product of brightness and reaction cross-section is equal to the number of events per second. The higher the brightness is, the more data can be obtained within a unit time. One special feature of the collider is that brightness varies with E^4 (E is the center of mass energy which is the sum of electron energy and positron energy). If the collider operates below its designed energy level E, its brightness drops rapidly. Therefore, a high energy collider cannot replace a low energy collider. Each has its own operating energy range. This explains the need to build a 5.6 GeV maximum center of mass energy collider such as the BEPC when the highest collider energy is approaching 100 GeV (center of mass) in the world. The operating range of the BEPC is 3 to 5.6 GeV which is the energy level for studying charmed particles. Many important physical problems have not yet bene resolved in this energy region. There is one other collider, named SPEAR, operating in this range in the world. The designed brightness of the BEPC is much higher than that of the SPEAR. At 3.1 GeV, its brightness is $5.2 \times 10^{31}/cm^2.s$, which is 9 times higher than of the SPEAR. Once the BEPC attains its designed brightness, it will be the best collider operating in this energy range. Scientists in China can take advantage of this situation to perform advanced studies.

At the present moment, the storage ring has reached $1.6 \times 10^{30}/cm^2.s$ in brightness (at 3.1 GeV center of mass energy).

3. Automatic Control and Beam Detection System

The automatic control system employs a VAX 11/750 computer as the main control unit. The CAMAC standard is adopted for the data collection, unit operation and control circuitry. Optical guide is used for long range signal transmission. It includes 20 optical guides, over 30 CAMAC units and more than 400 CAMAC cards in over 30 varieties. The system is also equipped with nearly 1,000 control cards and interface cards and is connected to nearly 800 devices (such as electromagnet power supplies, vacuum systems, high frequency systems, beam detectors). The automatic control system sends out more than 5,000 signals to various components of the collider to control the 800 devices. The beam detection system measures the characteristics of the beams. It is equipped with a variety of detectors, including beam position probe, beam intensity probe, wall current probe, beam current loss probe, synchrotron radiation probe and monitor.

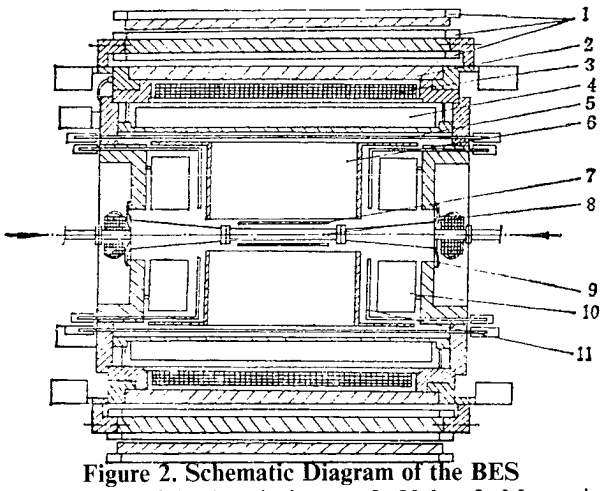

Figure 2. Schematic Diagram of the BES

Key: 1. μ particle descriminator; 2. Yoke; 3. Magnetic coil; 4. Barrel-shaped shower counter; 5. Barrel-shaped time of flight counter; 6. Main drift chamber; 7. Central drift chamber; 8. Beam channel; 9. Brightness monitor; 10. End cap shower counter; 11. End cap time of flight counter

4. The BES

The BES is a multi-purpose magnetic spectrometer (see Figure 2). The solid angle of detection is close to 4π, capable of distinguishing different types of charged particles and measuring their momenta. It can detect γ photons from several tens MeV to a few GeV. Its primary components include a beam channel, central drift chamber, main drift chamber, barrel-shaped time of flight counter, end cap time of flight counter, barrel-shaped shower counter, solenoid coil magnet, μ particle descriminator, brightness monitor, trigger descriminator, electronic read-out system, on-line data acquisition system and gas handling system. In order to analyze the data, one of the major development tasks is to develop an off-line data analysis system (software).

The beam channel in the BES is encircled by various detectors. Electrons and positrons collide in the channel. The central drift chamber and main drift chamber are located outside the channel. From the track left behind in these two chambers by a charged particle deflected by the magnetic field, it is possible to determine its momentum. The amount of energy lost in the main drift chamber can provide the information necessary to identify the particle. Outside the main drift chamber is the time of flight counter which records the time it takes the charged particle to travel from the collison point to the counter. It is used to identify particle type. Outside the time of flight counter is the shower counter which records photon and electron energy. Farther outside is the solenoid coil. Its maximum magnetic field strength is 0.45 T. Outside the coil is the 390 t yoke which is divided into three layers. The μ particle descriminator is also divided into three layers and each layer is attached to the outside of a yoke layer. The brightness monitor measures the brightness at the collision point. It is installed against the wall approximately 1.9 m away from both sides of the collision point. Various detectors, temperature sensors and pressure transducers generate more than 23,000 channels of electronic signals. There are more than 2,000 electronic cards and approximately 200 devices. The electronic read-out system also adopts the CAMAC standard. The trigger descriminator selectively records data of collision incidents based on pre-determined experimental conditions. A VAX11/785 computer is used to control and operate the BES and to record data.

Compared to the Mark III spectrometer in the SPEAR system, the BES is a great improvement. It will be the most advanced spectrometer operating in this energy region. The BES is being tested using cosmic ray. It is expected that experimental work can begin in mid 1989.

5. Synchrotron Radiation

The BEPC can provide synchrotron radiation in two modes. One is a concurrent mode where electrons and positrons collide and high energy physics and synchrotron radiation are achieved simultaneously. The other is a dedicated mode where only electrons are accelerated to produce synchrotron radiation. In this case the electron current intensity may be raised beyond that in concurrent mode. Consequently, the intensity of synchrotron radiation is also enhanced.

Two buildings will be built in the southern semi-circle (quadrants III and IV in Figure 1) of the storage ring for synchrotron radiation experiments. Each building will have 7 windows. In Phase I, we will only use three beam windows. Five beams and experimental stations will be built to satisfy the initial need. The first beam window is located in quadrant IV. A torsion magnet is used to bring out synchrotron radiation. It is split into two beams and we will build a crystal morphology station, a medical research station, an expanded X-ray absorption fine structure (EXAFS) station and a point defect diffuse scattering (Huang Kun scattering) station. The second window is also located in quadrant IV. A bending magnet is used to bring out synchrotron radiation. It is also divided into two beams. A diffraction station, a small angle scattering station and a optoelectronic station will be constructed around that window. The third window is located in quadrant III and synchrotron radiation is brought out by a bending magnet. A lithography station will be built by 1990.

III. Promoting Industrial Technology and High Technology in China

As mentioned earlier, because the BEPC project is a high technology project, it definitely will promote and stimulate the development of industrial technology and high technology in China. This is already happening. Let us

use the following seven examples to explain the situation. (1) Precision Machining. We needed large scale precision dies to stamp iron plates and cores for making magnets. The precision requirement is 25 μm. Back then not a single factory or research institute in China could do it. However, because of our need, Shanghai Xianfeng Electric Co. and High Energy Physic Institute of the Chinese Academy of Sciences developed dies for the bending magnet and quadrupole magnet, respectively. This advanced precision machining technology in China. (2) The output of Chinese made 10 cm microwave power tube (klystron) used to be only 16 MW. After we imported and digested advanced foreign technology, the High Energy Physics Institute of the Chinese Academy of Sciences an Hanguang Optoelectronic Co. under the Ministry of Mechanical and Electronic Industry have jointly developed a 30 MW klystron. This advanced technology has already been applied to the power tubes for radio and TV broadcasting. (3) The maximum current requirement for the high power supply for the magnet is 3500 A. The stability requirement is better than one ten thousandth over a long period of time. It was impossible to meet such requirements. (4) The power of the 200 MHz high power transmitter manufactured by the Beijing Radio Equipment Plant of the Ministry of Mechanical and Electronic Industry was raised from 25 kW to 100 kW upon demand. In the past, it was only tested for 72 hours in continuous operation. The current standard for continuous stable operation is 720 hours (i.e. one month). (5) The automatic control system of the collider has to collect over 5,000 signals 2-3 times per second in order to control every component. Some accuracy requirements are very high. For example, the power supplies for bending magnets and quadrupole magnets are controlled dynamically to an accuracy of one ten thousandth. This system is world class. (6) The BES has more than 23,000 electronic channels. In the past, a nuclear physics experiment typically only had several dozen channels. The scale has been increased by a factor of nearly a thousand. (7) Ultra-high vacuum components and pumps are in production. There are inquiries from the U.S. and Brazil with regard to performance and cost.

It is particularly worth noting that components for the BEPC are being manufactured and exported to earn foreign exchanges. The linear electron accelerator which is used as the injector performs well. The quality of this Chinese made accelerator tube is world class. In 1987 Brookhaven National Laboratories in the U.S. ordered two accelerator tubes and other accessories from the High Energy Physics Institute of the Chinese Academy of Sciences and the order was valued at $100,000. The tubes were delivered in Jun 88. Later, they ordered 6 more valued at $300,000. The High Energy Physics Institute has signed an agreement with Brazil to assist them to build an accelerator which is dedicated to synchrotron radiation. The accelerator tubes are being constructed. Argonne National Laboratories in the U.S. will order a number of accelerator tubes. The total value of the orders mentioned above is approximately $2,000,000.